# Daylight Harvesting

## Design Considerations

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Jarret Golwitzer has been working in the lighting controls market for more than five years and has been in the electrical industry for more than 14. Over the past five years, he has been actively engaged in designing and implementing lighting control systems in the Iowa and Nebraska markets through the engineering and construction community. Jarret is a certified CEU, AIA presenter and spends many hours in the classroom instructing engineers, distributors and contractors on proper technical and application of lighting control components.

# What is "Daylighting Design"?

- Designing spaces to use diffuse light from the sky.
- Use daylighting to provide the PRIMARY illumination within a space.
- Design the electric lighting system to SUPPLEMENT the daylight.
  - Make sure it is turned off when not needed.
  - Provide adequate light when no daylight is available.
- Includes the design of architectural and interior elements such as light shelves and shades to control daylight quantity and quality.

# What is NOT Daylighting?

- Too much daylight – a solar oven
- Incorrectly massed and oriented buildings
- A building with good daylight illumination BUT the electric lights burning away.

# Daylighting Design Principles

- Allow NO direct sun penetration, except in circulation spaces.
- Diffuse the light broadly through diffusing glazing and/or shading.
- Introduce daylight as high as possible,
- Use light colored surfaces.
- Keep brightest surfaces out of line of sight.
- Provide Shades, blinds or louvers where there is potential for glare or for audio-visual control.

# Lighting Controls Basic Principles

- Turn off lights when spaces are not in use.
- Turn off lights when there is adequate daylight.
- Dim lights if daylight levels vary.
  - Stepped dimming
  - Full range dimming
- Dim lights according to need.
  - Stepped dimming is fine in many spaces
  - Full range dimming is more costly but works better. This is often determined by space needs

# Integration with Daylight

- **Ensure harvesting of available daylighting.**
  - Use daylighting controls.
  - Study spaces to determine appropriate daylight amounts.
- **Provide daylight glare management.**
  - Determine direct solar glare situations.
  - Design manual or automatic blinds or other means of reducing the direct solar exposure glare and excessive light levels and heat gain.

# Daylight Sensors

- 2 Types
  - **Open**
    - Compare Ambient Electric Light output to incoming daylight.
  - **Closed**
    - Compare Ambient Electric Light to natural light at a location.

- Both types are subject to factors effecting the measured light levels.

# Open Circuit Sensors

- Compares ambient electric light output to incoming daylight.
  - Sensor reacts to the lighting directed to the sensor.
  - Cannot distinguish good light and glare.
  - Need to reduce the factors of light on sensor
    - Glare
    - Reflectance
    - Electric Lighting

# Open Circuit Sensors

- 3 D study of daylight infiltration.
  - Horizontal impact from
    - 0-90 degrees daily
      - East elevations
    - 90 – 180 degrees daily
      - West Elevations
    - 23 – 90 degrees
      - Based on time of year
        - » South Elevation
    - Reflectance
      - North Elevation

# Closed Circuit Sensor

- Compare Ambient Electric Light to Natural Light at a location.
  - Sensor reacts to the lighting directed to the sensor.
  - Cannot distinguish good light and glare.
  - Need to reduce the factors of light on sensor
  - Glare
  - Reflectance
  - Electric Lighting

# Closed Circuit Sensor

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# Closed Circuit Sensor

- Lighting evaluation is only for a specific location and not very accurate for a space.
- Many additional factors;
  - Paper color on a desk
  - Clothing colors by employees
  - Furniture colors
  - Any factor that will change the reflected light.

# Placement

- Sensors need to be placed to represent the "good" light provided naturally
- Minimum of 1 ½ times the window height.
- Placed to reduce or eliminate the factors of sunlight glare, direct or indirect and reluctances.

# Design Considerations

1. Ability for a single sensor to dim multiple zones.
2. Ability to be assigned a fixture at a time.
3. This will allow for the proper gain adjustment to a variety of zones.
4. 3D analysis of the buildings natural light penetration.
5. Properly designed Daylight Control and strategies.

# Daylight Harvesting Strategies

- On – Off
  - Pros
    - Energy Savings attained
  - Cons
    - Sudden change in light level annoys occupant. (Low Acceptance should be expected in occupied areas)
      - Did lamp burnout?
      - 50fc design = 50fc natural light to compensate for the Fixture. 50fc electric + 50fc natural = 100fc
      - To prevent on/off a dead bans must be included
      - 100fc x 1.25 = 125fc
      - 125fc to 50fc intently change instantly.

# Daylight Harvesting Strategies

- Step dimming
  - Pros
    - Reduce the effected levels of change.
  - Cons
    - 50fc design = +25fc natural light to compensate for the step Fixture. 50fc electric + 25fc natural = 75fc
    - To prevent on/off a dead bans must be included
    - 75fc x 1.25 = 93.75fc
    - 93.75fc to 50fc intently change instantly.

# Daylight Harvesting Strategies

- 1 – 100% Dimming
  - Cons
    - Traditionally Most expensive fixtures and system (No longer the case if wiring is considered as overall cost of job using digital system)
  - Pros
    - For every 1fc of additional natural light, 1fc of electric light is removed.
    - Seamless and not perceived by occupants.
    - Maintain fade rate below human sensory level.
    - One control zone vs. multiple control zones for stepped daylighting

# Questions?